

國立中正大學

111 學年度碩士班招生考試

試題

[第 2 節]

科目名稱	計算機概論(含程式設計)
系所組別	資訊工程學系-乙組

— 作答注意事項 —

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場；但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

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科目名稱：計算機概論(含程式設計)

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系所組別：資訊工程學系-乙組

1. (10%) Carefully examine the following sentences and give your answer, true (T) or false (F), for each sentence. Two points are given for each correct answer.

- (a) The worst-case time complexity of any sorting algorithm is $\Omega(n \log n)$.
- (b) If $f_1(n) = O(g(n))$ and $f_2(n) = O(g(n))$, then $f_1(n) = f_2(n)$.
- (c) The maximum number of nodes in a binary tree of depth k is $2^k - 1$.
- (d) $2\ 3\ 4\ \times\ +$ is the postfix expression of $2 + 3 \times 4$.
- (e) We cannot overload a function using the same number of parameters in C++.

2. (10%) Please write down the result of the following C++ code.

```
#include <iostream>
using namespace std;

class B {
public:
    B() { cout << "hi B" << endl; }
    virtual ~B() { cout << "bye B" << endl; }
};

class D: public B {
public:
    D() { cout << "hi D" << endl; }
    virtual ~D() { cout << "bye D" << endl; }
};

class DD: public D {
public:
    DD() { cout << "hi DD" << endl; }
    virtual ~DD() { cout << "bye DD" << endl; }
};

int main() {
    B * b_ptr = new D;
    D * d_ptr = dynamic_cast<D*> (b_ptr);
    if (d_ptr == nullptr) cout << "no d_ptr" << endl;
    DD * dd_ptr = dynamic_cast<DD*> (b_ptr);
    if (dd_ptr == nullptr) cout << "no dd_ptr" << endl;
    delete b_ptr;
    return 0;
}
```

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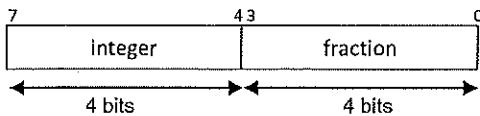
3. (8%) Please write down the result after we compile the C++ code. Then, please give the reason for the result.

```
#include <iostream>

class Money {
    int dollar;
public:
    Money (): dollar(0) {}
    Money (int _dollar): dollar (_dollar) {}
    const Money operator+(const Money& amount) const {
        return Money (dollar + amount.dollar);
    }
};

int main(){
    Money baseAmount (100), fullAmount;
    fullAmount = baseAmount + 25;
    fullAmount = 25 + baseAmount;
    return 0;
}
```

4. (12%) A rational number can be represented by the fixed-point representation. The fixed-point representation uses an implied binary point to separate integer part and fraction part. Assume that we have 8-bits fixed-point format to represent a number, where 4 bits for integer part and 4 bits for fraction part. Two's complement is used for signed values.



- (a) (4%) A signed number represented by the fixed-point format is 00100110_2 (Binary). What is its decimal value?
- (b) (4%) Represent the number -6.3125_{10} (Decimal) in the fixed-point representation.
- (c) (4%) IEEE-754 format and fixed-point representation are usually used to represent rational numbers. What are the advantage and disadvantage of using fixed-point representation?

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5. (16%) Explain the following terms:

- (a) (4%) Compiler
- (b) (4%) Interpreter
- (c) (4%) Assembler
- (d) (4%) Linker

6. (10%) Assume that we have eight registers (i.e., d0, d1, ..., d7) and the following instructions. Each register has 16 bits, bit 0 ~ bit 15. The operands `dst` and `src1` are registers. The operand `src2` is a register or an immediate value. The operand `n` is an immediate value. The immediate value is represented by a hexadecimal value with a leading "0x".

Instruction	Description
<code>AND dst, src1, src2</code>	Perform bit-wise AND operation on the value in <code>src1</code> and <code>src2</code> , store the result in <code>dst</code> .
<code>OR dst, src1, src2</code>	Perform bit-wise OR operation on the value in <code>src1</code> and <code>src2</code> , store the result in <code>dst</code> .
<code>ADD dst, src1, src2</code>	Perform addition operation on the value in <code>src1</code> and <code>src2</code> , store the result in <code>dst</code> .
<code>SHR dst, src1, n</code>	Move the bits in <code>src1</code> right by <code>n</code> bits. The left-hand <code>n</code> bits of <code>src1</code> are set to 0. The result is written to <code>dst</code> . $0 \leq n \leq 16$
<code>SHL dst, src1, n</code>	Move the bits in <code>src1</code> left by <code>n</code> bits. The right-hand <code>n</code> bits of <code>src1</code> are set to 0. The result is written to <code>dst</code> . $0 \leq n \leq 16$

- (a) (4%) Write the instructions to clear all the bits in register d1 to zero.
- (b) (6%) Write the instructions to extract the bit 5 ~ bit 10 of register d1 and to place it in the bit 0 to bit 5 of register d2. The bit 6 to bit 15 of register d2 are unchanged. d1 is unchanged.

7. (6%) The following C program is executed on a machine. The output at S1 is 18.

- (a) (3%) Is the byte order of the machine little-endian or big-endian?
- (b) (3%) What is the output at S2?

```
#include <stdio.h>

int main(void) {
    int a = 0x12345678;
    unsigned char *c = (unsigned char*)&a;
    printf("%d\n", *c); // S1
    printf("%d\n", *(c+3)); // S2

    return 0;
}
```

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系所組別：資訊工程學系-乙組

8. (22%) Given the following numbers: 37, 5, 26, 1, 61, 11, 59, 15, 48, 19, please answer the following questions.
- (a) (8%) Please sort these numbers in ascending order with the following quicksort function in C, where the swap function is used to swap two numbers. Note that the first number in each sublist is always selected as the pivot, and you must show necessary steps such that **the use of the quicksort function can be recognized**.
- (b) (7%) Assume that the numbers are input sequentially. Please construct a binary search tree without rotations.
- (c) (7%) Please construct a max heap by adding the numbers **one by one**. Please do not directly heapify it.

```
void quicksort(int a[], int left, int right)
{
    int pivot, i, j;
    while (left < right) {
        i = left;
        j = right+1;
        pivot = a[left];
        do {
            do i++; while (a[i] < pivot);
            do j--; while (a[j] > pivot);
            if (i < j) swap(&a[i], &a[j]);
        } while (i < j);
        swap(&a[left], &a[j]);
        if ( j - left < right - j ) {
            quicksort(a, left, j-1);
            left = j + 1;
        }
        else {
            quicksort(a, j+1, right);
            right = j - 1;
        }
    }
}
```

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9. (6%) The function `func` has two input parameters and exchanges their values. The output of the following program is "200 100". Complete the following program in (1), (2), and (3).

```
#include <stdio.h>

void func( (1) ) {
    (2)
}

int main(void) {
    int a = 100, b = 200;

    func( (3) );
    printf("%d %d\n", a, b);

    return 0;
}
```

